PhysicsLab-057	Light – Interference and Polarization

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1. Young's Double-Slit Experiment (Interference)

Condition of constructive interference (Bright lines)

i) $|l_1 - l_2| = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq d\sin\theta$

iii) $\rightarrow \quad d\sin\theta = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

iv) $d\sin\theta \fallingdotseq d\tan\theta \fallingdotseq d\frac{x_m}{L}$

v) $\rightarrow \quad x_m = m\frac{L\lambda}{d} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \quad \Delta x = x_{m+1} - x_m = \frac{L\lambda}{d}$

- Wavelength λ = 632.8 nm
- Slit Separation d = 0.40 mm
- (Slit width w = 0.10 mm)
- Distance between slit and screen L = 0.60

Theoretical value of Δx : 9.49×10^{-4}

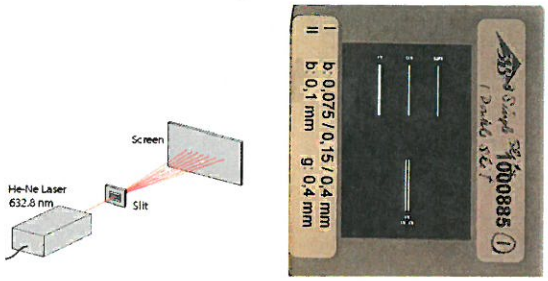
Measurement of X_m

- Order m = 3015
- Distance Xm = 41.42 $\times 10^{-2}$ cm

$\Delta x = X_m / 2m$

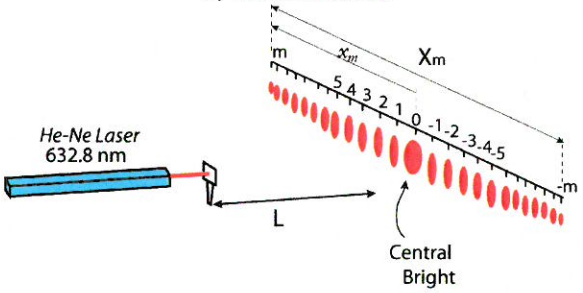
Observed value of Δx : 3.0×10^{-3}

A) Set up

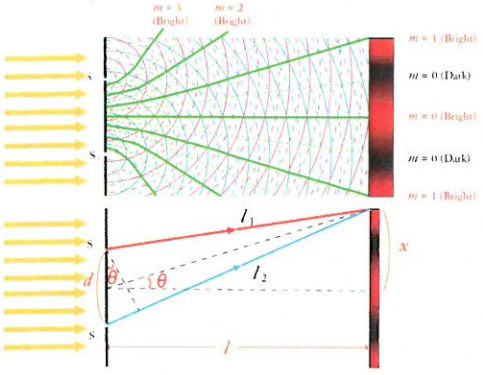


B) Fringes on Screen

C) Measurement



D) Mechanism of interference



2. Single-Slit Diffraction

Condition of destructive interference
(Dark lines)

i) $|l_1 - l_2| = (2m+1)\,\lambda/2 \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq \frac{W}{2} \sin\theta$

iii) $\rightarrow W \sin\theta = m\lambda \quad (m = 1, 2, 3 \cdots\cdots)$

iv) $W \sin\theta \fallingdotseq W \tan\theta \fallingdotseq W \frac{x_m}{L}$

v) $\rightarrow x_m = m \frac{L\lambda}{W} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \Delta x = x_{m+1} - x_m = \frac{L\lambda}{W}$

- Wavelength λ = 632.8 nm 10^{-9}
- Slit width W = 0.075×10^{-3}
- Distance between slit and screen L = 0.6

Theoretical value of Δx : $\frac{632.8\times10^{-9}\times0.6}{0.075\times10^{-3}}$ 5.0624×10^{-3}

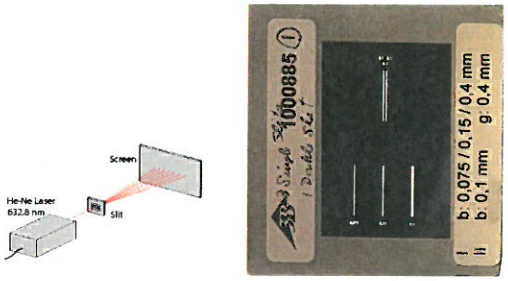
Measurement of X_m

- Order m = 4
- Distance Xm = 3.8×10^{-2}

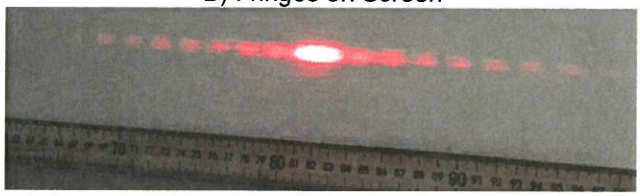
$\Delta x = X_m / 2m$ 0.95×10^{-2}

Observed value of Δx : 0.947×10^{-2}

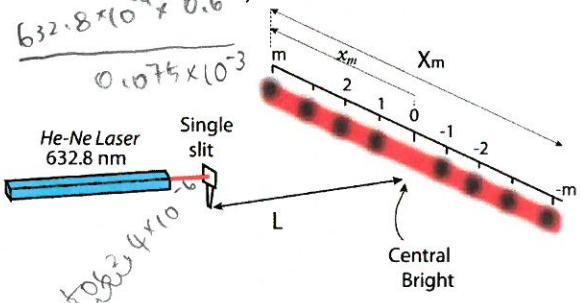
A) Set up



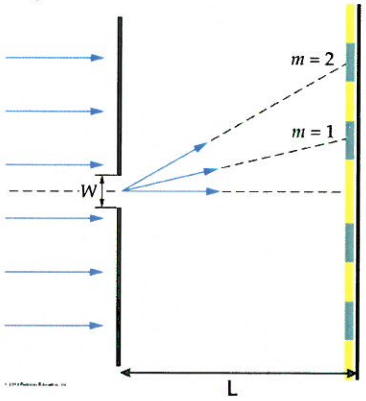
B) Fringes on Screen



C) Measurement



D) Mechanism of interference



3. Diffraction Grating

Condition of constructive interference (Bright lines)

i) $|l_1 - l_2| = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq d\sin\theta$

iii) $\rightarrow d\sin\theta = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

iv) $d\sin\theta \fallingdotseq d\tan\theta \fallingdotseq d\frac{x_m}{L}$

v) $\rightarrow x_m = m\frac{L\lambda}{d} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \Delta x = x_{m+1} - x_m = \frac{L\lambda}{d}$

- Wavelength λ = 632.8nm
- Grating lines/mm N = 100
- Slit Separation $d = \frac{1\times10^{-3}}{N}$ 1.0×10^{-5} (m)
- Distance between slit and screen L = 0.600

Theoretical value of Δx : 3.8×10^{-2}

Measurement of X_m

- Order m =
- Distance Xm =

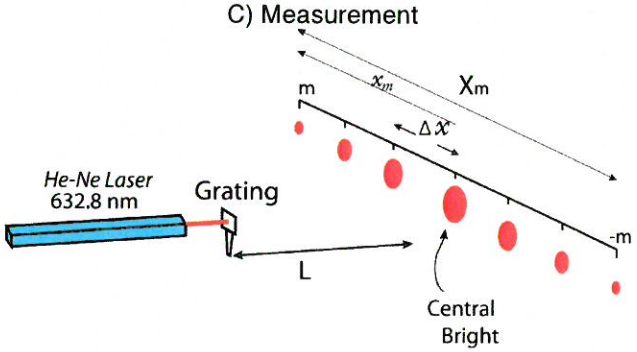
$\Delta x = X_m / 2m$

Observed value of Δx : 3.5×10^{-2}

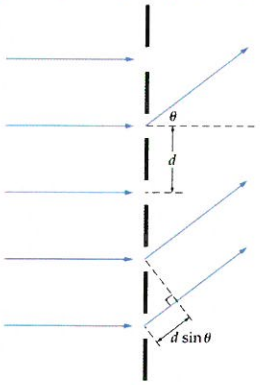
A) Set up

B) Fringes on Screen

C) Measurement



D) Mechamism of interference



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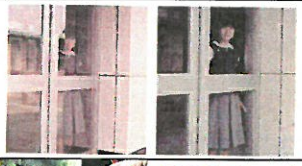
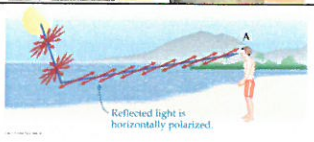
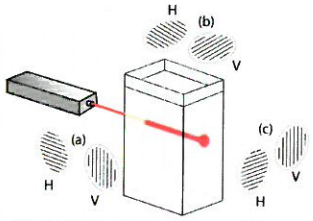
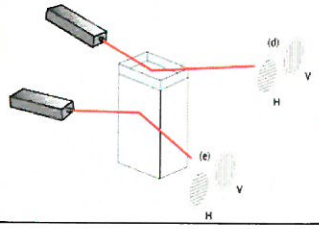
Polarization

			Results
1	Reflected light on the windows		+ 見える　波が垂直に来ているとPolarize − 見えない
2	Reflected light on the water surface		+ 見えにくい　光が水平に来ているから − 見える
3	Reflected light outside, such as road suface and water surface		+ 暗くなる　光が水平に来ているから − 明るい
4	Blue sky	 Interestingly, the blue sky is also polarized.	+ 暗くなる　光が斜め水平に来ているから。 − 明るい
5	Water including milk	 The direction depends on the places	(a) Hだとライトは見えなくなりVだとくっきり見える。 (b) H消える　V見える (c) H　も　V　も変わらない
6	Reflection		(d) H見えない　V見える (e) H見えない　V見える
7	Opinions すべての赤い点の長さをはかるのかと思ったら、自分で決めて十分すればいい結果が出ると分かってすごく分かりやすかった。光の平行によってPolarizationの結果が変わることが、実験をとおして理解をふかめられた。		